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Environmental
Commissioner
of Ontario

# BROADENING ONTARIO'S CLIMATE CHANGE POLICY AGENDA

## Annual Greenhouse Gas Progress Report 2010

Action delayed is effectively results denied.*

* National Round Table on the Environment and the Economy, 2009. *Achieving 2050: A Carbon Pricing Policy For Canada*, 100.

Front cover image: GO Train over DVP courtesy of GO Transit/Brian Main

Environmental
Commissioner
of Ontario

Commissaire à
l'environment
de l'Ontario

Gord Miller, B.Sc., M.Sc.
Commissioner

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Commissaire

May 2010

The Honourable Steve Peters
Speaker of the Legislative Assembly of Ontario
Room 180, Legislative Building
Legislative Assembly
Province of Ontario
Queen's Park

Dear Speaker:

In accordance with section 58.2 of the *Environmental Bill of Rights, 1993*, I am pleased to present the Annual Greenhouse Gas Progress Report 2010 of the Environmental Commissioner of Ontario for your submission to the Legislative Assembly of Ontario. This Annual Report complements my progress report submitted to you in December 2009 and provides a discussion of the implications and opportunities associated with expanding Ontario's climate change policy agenda.

Sincerely

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# Executive Summary

This report represents the Environmental Commissioner of Ontario's (ECO's) second Annual Greenhouse Gas Progress Report. Under the *Environmental Bill of Rights, 1993*, the ECO is responsible for reporting annually to the Speaker of the Assembly on the progress of activities in Ontario to reduce greenhouse gas emissions. In fulfilling this mandate, the ECO is to review any annual report on greenhouse gas reductions or climate change published by the government in the year covered by the ECO report. In December 2009, the ECO released our first progress report less than a week after the release of the government's Climate Change Action Plan Annual Report 2008-09. The ECO has subsequently decided, however, that the public interest would be better served if our annual greenhouse gas progress reports are issued in the spring. By moving to a later release, the ECO will be in a better position to more thoroughly fulfill our reporting mandate.

This report contains a brief summary of greenhouse gas emissions data that has become available since December 2009. The data comes from the April 2010 release of Environment Canada's National Inventory Report, published as part of Canada's reporting commitments to the United Nations Framework Convention on Climate Change Secretariat. According to Canada's 2010 National Inventory Report, Ontario's total greenhouse gas emissions for 2008 were 190.3 megatonnes as measured on a carbon dioxide equivalent basis.[1] This amount represents a five per cent reduction from the 200 megatonnes reported for 2007 in the same National Inventory Report.

At this point, the ECO has no information to conclude that any of the decreases reflected between 2007 and 2008 in four of the six sectors (transportation, industry, buildings and agricultural) result from Climate Change Action Plan initiatives. In the electricity sector where greenhouse gas emissions have declined, the ECO attributes these reductions to the continued winding down of coal use at the four remaining power plants using this fuel. Given that the Climate Change Action Plan was formally launched only in 2007 and

that the data presented is from 2008, it would be unreasonable to assume that any significant reductions could be attributed to measures taken within a one-year timeframe.

In our Annual Greenhouse Gas Progress Report 2008/2009, the ECO raised several areas in need of further policy development. The majority of this current report is devoted to broadening the climate change policy agenda. In particular, this report provides a discussion of greenhouse gas targets and the need to revisit them on the basis of recent scientific evidence indicating that, at current carbon dioxide equivalent concentrations in excess of 390 parts per million, the global community is moving dangerously close to a key tipping point.

This report also discusses the implications of Ontario Power Generation's plans to use biomass as a renewable energy source at its four coal-fired generating stations. While the ECO supports this idea in principle, further analysis needs to be done. The ECO sees a pressing need for further time-sensitive modelling of overall forest carbon levels in order to assess the assumption of "carbon neutrality" in the context of Ontario Power Generation's plans to use wood pellets as a fuel source.

In previous reports, the ECO has strongly supported the government's stated intention to establish a process for verifying Climate Change Action Plan results.[2] In addition to verifying the accuracy of the data that will be reported, the ECO has also stressed the need for verification of processes that are in place to ensure that roles and responsibilities of key line ministries and related agencies are clear and that accountabilities for Climate Change Action Plan results are public and transparent.

Recognizing the nearly one-third share that the transportation sector represents both in terms of greenhouse gas emissions and the consumption of energy in Ontario, this report discusses the role that road pricing could play as a transportation demand management tool to ease traffic congestion and reduce greenhouse gas emissions and related criteria air contaminants while providing much-needed revenues to fund an expanded public transit network.

This report also broadens the policy discussion in terms of how to put a price on carbon to send a clear and transparent price signal into the marketplace. The ECO notes that the Ontario government's public consultation process on carbon pricing to date has focused only on one policy instrument: cap-and-trade. The ECO believes there is a need for a reasoned and balanced discussion comparing and contrasting emissions trading and a carbon tax in terms of their efficacy in ensuring carbon price discovery in the economy while reducing greenhouse gas emissions.

The report concludes with a series of recommendations designed to assist the government in achieving its two key Climate Change Action Plan objectives: the reduction of greenhouse gas emissions and the transition to a low-carbon economy.

# 1 – Setting the Context

## 1.1 – Changing the ECO's Reporting Date

In December 2009, the ECO released our first Annual Greenhouse Gas Progress Report (GHG Progress Report) very soon after the government released its Climate Change Action Plan Annual Report 2008-09 (CCAP Annual Report 2008-09). While there is some value in issuing our greenhouse gas (GHG) progress reports on the heels of the government's CCAP annual reports, the ECO has reached the conclusion that the public interest would be better served if our reports are issued in the spring. By moving to a later release, the ECO will be in a position to more thoroughly review, respond to, and make future recommendations relating to any reports issued by the government.

As well, this change in the ECO report release date will allow the ECO to utilize the most recent GHG emissions data for Ontario, and report in a timely fashion on the province's annual progress towards its GHG reduction targets, as provincial emissions data is released by the federal government annually in April. Accordingly, in the future the ECO will release our annual GHG progress report each spring and our reporting period will be based on the government's most recent CCAP report.

## 1.2 – Climate Change Action Plan Annual Report 2008-09

In 2007, the government introduced its Climate Change Action Plan (CCAP). Within the plan, three GHG reduction targets were established:

- 6 per cent below 1990 levels by 2014;
- 15 per cent below 1990 levels by 2020; and
- 80 per cent below 1990 levels by 2050.

These targets were reiterated in the government's CCAP Annual Report 2008-09.[3] In order to reach the first, short-term target, Ontario must reduce its emissions to 165 megatonnes (Mt) and, by 2020, must reduce emissions to 149 Mt.[4] Within its CCAP Annual Report 2008-09, the government described several current and planned initiatives that are forecast to reduce emissions in the years ahead. In total, the government forecasts these initiatives will deliver reductions of 34.4 Mt by 2014 and 43.8 Mt by 2020.[5] Based on the initiatives identified to date, however, these reductions will not be sufficient for the government to reach its targets. The initiatives will bring the province 71 per cent of the way towards its 2014 target, and 56 per cent of the way towards its 2020 target.[6] The ECO noted in our last progress report that the government must find more GHG reduction tools for its CCAP toolkit to close these short-term and medium-term gaps.

As of May 2010, the ECO was unaware of any further initiatives planned by the government for its GHG reduction toolkit. This is not to say, however, that new initiatives are not being reviewed and assessed. With the passage of the *Green Energy and Green Economy Act, 2009* and the introduction of the Feed-in Tariff program by the Ontario Power Authority (combined with its previous commitment to phase-out coal), the government has signaled its strong intention to shift away from fossil fuels for electricity generation. The ECO awaits the announcement of further initiatives in other sectors beyond electricity and will review and comment on them in our next progress report to be released in the spring of 2011.

## 1.3 – The Numbers to Date – Canada's 2010 National Inventory Report

### 1.3.1 – Explanation of the Numbers

Each year, Canada submits its National Inventory Report (NIR) to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat. The NIR provides the most recent GHG data for Canada, as well as for each of the provinces. It also provides historic data for both overall totals, as well as each sector, that is oftentimes restated. These restatements are a result of continual evaluation and improvements to the way emissions estimates are modelled and calculated. The ECO recognizes that both historic and current emissions estimates always carry some uncertainty. As scientific knowledge expands, improvements to emissions modelling and estimates will continue to occur.

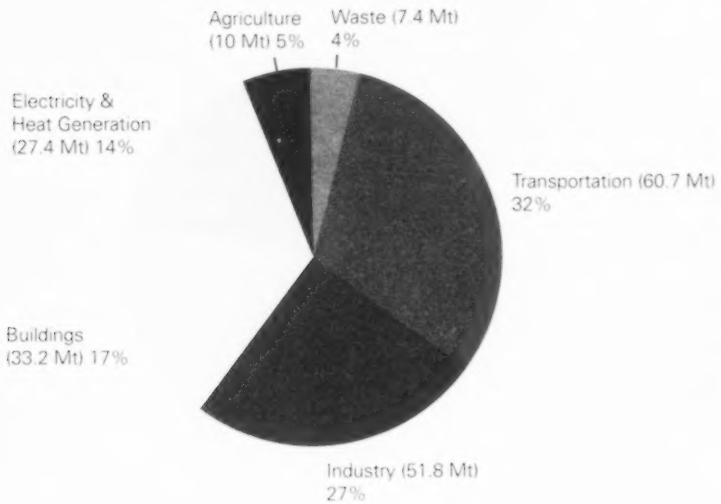
To ensure that the most accurate data is used, the ECO has relied in this report on the most up-to-date NIR sector data. The ECO expects that this will be the approach used by the government as well.

Accordingly, historic numbers for some years may not align precisely with data on which the ECO (and the Ontario government) have previously reported and commented. In this year's NIR, for example, slightly different emissions totals were reported for 1990 and for some 1990 sectors. As well, total emissions from 2007 were revised, and adjustments were made to some 2007 sector totals. These restated historic totals have no significant impact on Ontario's overall targets. The ECO discusses in Section 2.3 our expectation that the CCAP verification process should begin capturing its own data to complement the NIR numbers.

### 1.3.2 – 2008 Emissions Totals

According to the 2010 NIR, Ontario's total GHG emissions for 2008 were 190 Mt as measured on a $CO_2$ equivalent ($CO_2$ eq) basis.[7] This amount represents a five per cent reduction from the 200 Mt reported for 2007 in the same NIR. The 2008 amount exceeds Ontario's 1990 base year emissions of 176 Mt by 14 Mt, or 8 per cent.[8] This 18-year rise is primarily due to increased emissions from buildings, road transportation, and other forms of transportation such as domestic aviation and off-road diesel and gasoline.[9]

**Figure 1 – Ontario's 2008 GHG Emissions by Sector**
*(Source: 2010 National Inventory Report)*


Agriculture (10 Mt) 5%
Waste (7.4 Mt) 4%
Electricity & Heat Generation (27.4 Mt) 14%
Transportation (60.7 Mt) 32%
Buildings (33.2 Mt) 17%
Industry (51.8 Mt) 27%

### 1.3.3 – The Sectors in Brief

**Transportation**

In 2008, the transportation sector was responsible for 61 Mt, or 32 per cent of Ontario's overall emissions. In absolute tonnes, this is a slight decrease from 2007. In 1990, the transportation sector was responsible for 45 Mt[10] so, by 2008 Ontario's emissions for this sector were 35 per cent higher than the 1990 level.

Similar to 2007, road transportation represents the largest portion of transportation's overall 2008 emissions with about 48 Mt. Of this amount, passenger vehicles were again responsible for the majority

of these emissions: almost 35 Mt. Responsible for the largest portion of Ontario's GHG emissions, a wide range of strong initiatives will be required to drive down transportation's overall contributions – no single silver bullet exists. Well-designed land-use planning and urban transportation policies can help to move people out of their vehicles. Changes to vehicle technologies, such as electrification or increased fuel efficiencies, can also have an impact on emissions reductions. Finally, policies that affect commuter choice, such as higher price signals (see Section 2.4), may also play a significant role.

In terms of strengthening land-use planning provisions, a key opportunity exists with the current review of the Provincial Policy Statement (PPS). On May 12, 2010, the Ministry of Municipal Affairs and Housing posted a proposal notice on the Environmental Registry soliciting public input on the PPS review.[11] This review offers a key opportunity for public review of alternative transportation options such as revisiting provincial highway expansion plans, providing more opportunities for active commuting and strengthening provisions that constrain urban sprawl.

Changes to vehicle technologies can also play a key role in reducing GHG emissions. In this regard, a key initiative identified by the province focuses on mandatory fuel efficiency standards. Until recently, no federal regulatory requirements for fuel efficiency standards have existed in Canada. Instead, a voluntary commitment existed on the part of industry to meet U.S.-equivalent targets.[12] In April 2010, the federal government released its proposed Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations.[13] Designed to harmonize with the mandatory national standards in the United States, the regulations are projected to come into force for the 2011 model year.

Compared with vehicles sold in 2008, Environment Canada projects that the average GHG emissions of new vehicles sold in the 2016 model year will be about 25 per cent lower.[14] According to the CCAP Annual Report 2008-09, the proposed federal fuel efficiency standards are estimated to result in emission reductions of 2.24 Mt by 2014 and 5.45 Mt by 2020.[15]

Projected increases in population and corresponding vehicle ownership, however, will likely limit the overall impact that these new emission standards will have. As Metrolinx recognizes for the Greater Toronto and Hamilton area, the challenge "of adding 2.6 million people to [the] region [by 2031] while trying to reduce or even maintain existing levels of emissions should not be underestimated."[16] Further, the new fuel efficiency regulations do not apply to freight trucks, which is significant given the growth in freight related emissions. In Ontario alone, GHG emissions from road-based freight transportation have increased by 57 per cent since 1990.[17] In April 2010, however, the federal Environment Minister indicated that standards for heavy-duty trucks would be introduced within the next few months.[18]

Increased public transit is a key element of any climate change reduction plan. In its 2010 budget, the government deferred $4 billion in public transit investments over the next five years.[19] This amount represents almost half of the $9.3 billion in funding previously announced for transit projects across the Greater Toronto region. The ECO is concerned about the impact this deferred funding will have on the investment in infrastructure that can assist in generating the needed modal shift from single-occupant vehicles (SOVs) to transit.

**Industry**

In 2008, the industrial sector was responsible for almost 52 Mt, or 27 per cent of Ontario's overall GHG emissions. Similar to the electricity sector, which witnessed a significant one-year decrease in emissions due to the economic downturn, this sector's emissions decreased by 4 Mt, or 7 per cent when compared with 2007. In 1990, this sector was responsible for almost 62 Mt. In 2008, GHG emissions for this sector were 16 per cent below 1990 levels. In part, this reduction was due to a decrease of 8.5 Mt within the chemical industry from 1990 levels.[20]

Within the industrial sector, manufacturing saw a reduction in GHG emissions of almost 3 Mt between 2007 and 2008, or a decrease of about 12 per cent.[21] The reduction in emissions is a function of decreased manufacturing during this time period. Automobile production alone, which is a major component of the Ontario economy, saw a significant decline in 2008, with a subsequent continued decline of almost 29 per cent in 2009.[22]

Fossil fuel production and refining also experienced reduced emissions in 2008 of more than 1 Mt when compared with 2007.[23] Within the broader industrial sector, however, these reductions were offset somewhat by increases in both the chemical industries and ammonia production[24] over the one-year period.

**Buildings**

In 2008, the building sector was responsible for 33 Mt, or almost 18 per cent of Ontario's overall emissions. In absolute tonnes, this is a marginal decrease of 0.2 Mt, or less than one per cent, from 2007. In 1990, the building sector was responsible for 26 Mt. Since then, GHG emissions from buildings have increased by over 7 Mt and are 28 per cent higher than 1990 levels.

**Electricity**

In 2008, the electricity sector was responsible for over 27 Mt, or 14 per cent of Ontario's overall GHG emissions. In 1990, this sector contributed just under 27 Mt. In 2008, emissions from electricity production were 3 per cent higher than the 1990 level.

In 2008 there was a decrease of almost 5 Mt, or 14 per cent from 2007 totals. This significant decrease is unsurprising given the general decline in electricity demand in 2008 due to milder weather, economic conditions and increased conservation efforts.[25] As well, Ontario Power Generation (OPG) - which provides approximately 70 per cent of Ontario's electricity[26] - witnessed an increase in electricity production from its nuclear and hydro facilities during the year,[27] along with a 20 per cent reduction in electricity production from its five fossil fuel facilities.[28] Of these five facilities, four utilize coal - which has high GHG emissions - as a fuel.

Partially to offset the loss of coal-fired electricity production, the Ontario Power Authority (OPA) has been moving aggressively towards procuring renewable energy generation over the past several years. At the beginning of October 2009, the OPA began accepting applications for its Feed-in Tariff (FIT) program which is designed to significantly expand renewable energy generation in the province. As of April 2010, 694 mid- to large-scale projects have been awarded contracts, representing over 2,500 megawatts (MW) in generating capacity. Several thousand smaller projects have also received conditional offers through the microFIT program.[29]

**Agriculture**

In 2008, the agricultural sector was responsible for 10 Mt, or five per cent of Ontario's overall emissions. In absolute tonnes, this is a decrease of 1 Mt from the 11 Mt reported for 2007. As well, 11 Mt represents 1990 levels for this sector.

**Waste**

In 2008, the waste sector was responsible for over 7 Mt, or four per cent of Ontario's overall emissions. In absolute tonnes, there was no increase or decrease from 2007 levels, however, emissions from this sector in 2008 were close to 28 per cent higher than the almost 6 Mt levels reported for 1990. Regulations enacted in 2008 increased the number of Ontario municipal landfills that are required to have landfill gas collection systems in place. These collection systems are forecast to result in a reduction of 2.19 Mt from this sector by 2014.[30] As the ECO indicated in our GHG Progress Report 2008/2009, a critical re-evaluation of some underlying assumptions may be required to ensure that the forecasted reductions are real and verifiable.[31]

| | 1990 Totals (Mt) | 2007 Totals (Mt) | 2008 Totals (Mt) | Percentage Change from 1990 - 2008 |
|---|---|---|---|---|
| **Sectors:** | | | | |
| Transportation | 45.0 | 61.1 | 60.7 | +34.9 |
| Industry | 61.8 | 55.8 | 51.8 | -16.2 |
| Buildings | 26.0 | 33.4 | 33.2 | +27.7 |
| Electricity and Heat Generation | 26.6 | 32.0 | 27.4 | +3.0 |
| Agriculture | 11.0 | 11.0 | 10.0 | -9.1 |
| Waste | 5.8 | 7.4 | 7.4 | +27.6 |
| **TOTALS (as reported in the 2010 NIR)** | **176.0** | **200.0** | **190.3** | **+8.0** |

### 1.3.4 – Summary

Given the downturn in the economy in 2008 and 2009, along with a contraction in the manufacturing sector, it is not surprising that an overall decrease in emissions was recorded for 2008 compared with 2007. In 2008, real GDP dropped by 0.5 per cent, followed by a reduction of 3.4 per cent in 2009.[32] In the 2010 budget, however, the government projected that real GDP would grow by 2.7 per cent in 2010 and 3.2 per cent in 2011.[33] From an emissions reductions perspective, the key challenge going forward will be to ensure that overall emissions continue to trend downwards, despite the projected upswing in economic activity. A second key challenge is for the government to put in place a verification process that demonstrates that any reductions claimed are due to mitigation initiatives, rather than economic fluctuations. This will aid in determining the extent to which GDP output and GHG emissions are decoupling.

# 2 – Broadening the Policy Discussion

In our most recent annual GHG Progress Report, the ECO noted that Ontario's GHG reduction targets, while more ambitious than those in many other jurisdictions in North America, could not be considered "aggressive" given the growing scientific consensus that "aggressive" targets out to 2020 are more likely to be considered in the range of 25 to 40 per cent below 1990 levels. This is discussed in Section 2.1 below.

In our Annual Report 2008/2009: Building Resilience, the ECO expressed concerns about the Ministry of Natural Resources' forest biofibre policy, and its focus on using biofibre for energy production. The ECO felt that this policy could lead to a short-term carbon "surge" by releasing "large amounts of $CO_2$ that will not be re-sequestered for decades."[34] This issue is explored in more depth in Section 2.2.

In last year's GHG Progress Report, the ECO supported the government's intention to establish a process for verification of CCAP results. Section 2.3 provides a discussion of key verification principles that will have application to the CCAP.

The ECO's first Annual Energy Conservation Progress Report – 2009 (Volume One) echoes concerns expressed in last year's GHG Progress Report that other transportation demand management policy levers, including road pricing, need serious public debate if transportation-related GHG emissions are to be reduced. Section 2.4 elaborates on possible areas of focus.

Finally, Section 2.5 offers a discussion of the broader policy options and implications of putting a transparent price on carbon, including a comparison of a cap-and-trade system and a carbon tax, and their potential to assist the government in achieving its GHG reduction targets.

## 2.1 – Revisiting Ontario's Greenhouse Gas Reduction Targets

There is unequivocal evidence that GHG concentrations in the atmosphere are rising at an alarming rate. Preindustrial concentrations of $CO_2$ in the atmosphere are known to be about 280 parts per million (ppm) and have more recently been measured with great precision on the Mauna Loa Observatory in Hawaii since March 1958. The average concentration of $CO_2$ for that month 52 years ago was 315.71 ppm. In March of 2010 the average was 391.26 ppm[35] and rising at an accelerating rate which is presently about 2 ppm per year.

Article 2 of the UNFCCC states that the convention's objective is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent "dangerous anthropogenic interference with the climate system." The convention did not specify, however, what that level might be.

In 2007, the international discussion on what might be a tolerable level to avoid dangerous climate alteration and species loss focused on stabilizing at 450 ppm $CO_2$. At that time it was thought that a concentration of 450 ppm would be exceeded by business-as-usual (BAU) by about 2040, thus giving some breathing room for a global response. Additional support for 450 ppm as a maximum came from studies of oceanic acidification by atmospheric $CO_2$ which predicted that soluble calcium carbonate (CaCO3) levels would drop below saturation such that crustaceans could not produce shells and coral reefs could not grow.[36]

In that 2007 policy context, Ontario set its GHG reduction targets (relative to 1990) of 6 per cent by 2014, 15 per cent by 2020 and 80 per cent by 2050. These are levels which the ECO has characterized as less than aggressive given current policy discussion at the Intergovernmental Panel on Climate Change and in recent scientific literature. It has become evident by analyzing paleo-climatic data that allowing the atmosphere to reach and maintain 450 ppm of $CO_2$ would activate positive feedback mechanisms on climate warming such as ice sheet disintegration and release of methane from soils and ocean sediments on time scales which would be disruptive to humanity and other life forms this century. Climate models predict that the equilibrium state[37] for earth at 450 ppm is ice free, a totally different world from that in which our civilizations have evolved.[38]

So if a 450 ppm world is not feasible, what is? Regrettably, the same analysis also shows that the 390 ppm world we already have will generate unacceptable consequences. The changes that are occurring (sea level rise, glacial and ice sheet melting, ocean acidification, and coral reef loss) are all indications that the earth is not in energy balance. The ultimate impacts on climate and the biosphere that the 390 ppm atmosphere will produce have not yet played out. The target must be lower; the best science indicates much lower.

The target for atmospheric equilibrium concentration of $CO_2$ now recommended by an informed consensus of climate change scientists is 350 ppm. This of course is much lower than the present level,

but there is still opportunity to avoid the worst scenarios. The same climate inertia of the oceans' currents and ice sheet albedo[39] that slow the deleterious effects of our 390 ppm atmosphere mitigate the impacts of overshooting 350 ppm and buy us time to reverse the GHG accumulation if that is indeed possible.

So policy objectives to obtain a 350 ppm world are required and the urgency of reducing GHG emissions from all sources is higher than ever. Certainly the global community must find a way to put a price on carbon soon, but new tools to de-carbonize our economies also must be found. The major new component of policy imposed by a 350 ppm goal is that mechanisms that actually *reduce* the $CO_2$ that is already in the atmosphere must be explored. Fortunately for Ontario opportunity exists in at least two areas.

An oft-ignored, yet significant, component to the atmospheric concentration of $CO_2$ that now exists is the carbon that was released by the extensive deforestation that took place over the past two centuries and continues today. The extent of deforestation is something that can be reversed to some degree over the coming decades by reforestation on a wide-spread scale. Ontario has initiated some modest efforts in this regard but much greater opportunities exist. Ontario also has considerable expertise in this field that could be put to good use in international initiatives toward global reforestation.

Another option with significant potential for sequestering the carbon emissions of the industrial world is referred to as biochar. Originally used by ancient peoples to improve poor soils, biochar (known as charcoal when made from wood) is one of the residual products of heating organic material in an oxygen-limited environment. This process, known as pyrolysis, can convert many other organic residues, such as those from agriculture, municipal waste streams, and forestry, into both a useful fuel (bio-oil) and biochar. The bio-oil can be processed into a fossil fuel alternative; the biochar component has two major benefits.

The first benefit arises from the fact that most of the carbon in biochar is stable for hundreds, even thousands of years. It resists decomposition by microbes in the soil. In essence, the concept is one of delaying the carbon cycle. Biological material that has been created by fixing atmospheric carbon through photosynthesis ordinarily delivers its carbon back into the atmosphere when the organic material decomposes. By delaying this decomposition, biochar effectively sequesters the carbon in soil. The second benefit is also soil-related. Studies show that biochar, when added to soil, enhances nutrient capacity, increases moisture retention and builds biological biodiversity, substantially improving fertility and resilience.

Policy initiatives promoting reforestation and biochar sequestration would be useful and complementary tools within a global climate change mitigation strategy struggling to cope with a 350 ppm $CO_2$ target. In recognition of the 350 ppm issue, the ECO believes that the CCAP targets identified in 2007, although useful as a starting point, need to be revisited in light of 2010 scientific information.

**The ECO recommends that the Ontario government undertake a formal public review of its CCAP GHG targets in light of scientific evidence indicating concentrations of GHGs in the atmosphere are unacceptably high.**

## 2.2 – The Role of Forest Biofibre

The government's commitment to stop burning coal at the province's remaining coal-fired power plants by 2014 represents a significant and laudable step towards reducing GHG emissions in the province. According to the government, this single initiative will be responsible for 26.4 Mt, or 77 per cent of the government's forecasted emissions reductions for 2014.[40]

Operated by OPG, the four coal-fired power plants have a combined capacity of 6,077 MW. These plants operate as needed and, in 2008, $CO_2$ emissions from these facilities were 23 Mt,[41] a significant decrease from 27.8 Mt in 2007.[42] Emissions from these stations will continue to decline as OPG takes measures to comply with directives from the Ontario government. In particular, these directives require OPG to reduce its $CO_2$ emissions from its coal-fired power plants to 19.6 Mt for 2009 and 15.6 Mt for 2010.[43] By 2011, OPG forecasts that emissions will be lowered to 11 Mt.[44] Pursuant to Ontario Regulation 496/07 – Cessation of Coal Use, made under the *Environmental Protection Act*, none of these stations will be permitted to burn coal after December 31, 2014.[45]

The ECO notes that these power stations will not be mothballed and it is expected that they will continue to emit $CO_2$ whether as a result of conversion to biomass or to natural gas. Even with the expected increase in renewable generation, these stations are likely to continue in operation. A factor in support of this observation is the government's recent retreat from making a decision on new nuclear.[46]

As part of its efforts to phase-out coal, OPG is now assessing the use of biomass as a renewable energy source for up to 11 of the 15 units at its four coal-fired stations.[47] Biomass is the biological material derived from living, or recently living organisms, such as trees and grasses. OPG's focus is on both forest products (wood pellets) and agricultural biomass and 2012 is targeted as the year OPG will begin using biomass as a replacement fuel.[48]

Engineering work is currently underway to completely convert the Atikokan facility to use wood pellets, and it is anticipated that the facility's capacity when operating with pellets will be close to that reached when operating with coal.[49] At the Thunder Bay facility, OPG is exploring the conversion of one of two units and is assessing whether full electrical output capability can be reached. At the Nanticoke and Lambton facilities several of the 12 units will be converted, however OPG projects that when compared with existing coal-fired operations, the use of biomass at these units will result in much lower annual electricity production. Due to several technical issues, Nanticoke's capacity on wood pellets is estimated to be 50 per cent of its coal-fired capacity.[50]

Once OPG's conversion program is complete, it anticipates that annual biomass fuel requirements will be in the range of two to three million tonnes of wood pellets, an amount that represents about 20 per cent of the total annual allowable forest harvest in Ontario.[51] At Atikokan alone, approximately 90,000 tonnes of wood pellet fuel will be required, or approximately two per cent of the 2005/2006 harvest in northwest Ontario.[52]

According to OPG, there are several benefits associated with a conversion to biomass. As is the case with coal, electricity production using biomass is dispatchable, which means that it can easily be shut down or brought back online. Given the intermittent nature of other renewable energy generators (such as wind and solar), this provides the power grid with increased flexibility. As well, because existing plants can be converted to biomass, capital costs will be low. Finally, replacing coal with biomass will help to reduce OPG's coal-related GHG emissions. A life-cycle analysis conducted for OPG in 2009 compared the GHG emissions associated with the use of wood pellets (made from harvested wood) versus coal. For the Nanticoke and Atikokan facilities, the analysis concluded that reductions in GHG emissions of 91 and 92 per cent,[53] respectively, would result if coal is completely replaced by wood pellets, whereas an 18 per cent reduction would result if wood pellets and coal are co-fired in a 20/80 ratio.[54]

Given the constraints, however, on the volume of pellets that would be available (based on the goal of maintaining a sustainable forest harvest), the overall GHG reductions that could be achieved by pellet-generated electricity is 2.1 Mt.[55] When measured against the approximately 23 Mt that were emitted in 2008, this represents a 9 per cent reduction in emissions. As a portion of Ontario's overall electricity supply, pellet-generated electricity would provide only 1.6 per cent of Ontario's total electricity supply at current demand levels.[56] In order to increase the possible GHG reductions from biomass, OPG is also exploring the use of agricultural materials, both by-products and purpose-grown, and has contracted to have a similar life-cycle analysis conducted for these feedstocks.[57]

Forests and plants serve a key function in the carbon cycle. As they grow, they sequester $CO_2$ from the atmosphere during photosynthesis and store it both above ground in stems, branches and leaves, as well as below ground in roots. The process, however, may take many years and forests in particular are slow to regenerate. When the above-ground biomass is burned to produce electricity, however, the carbon dioxide within is released immediately to the atmosphere. Over the long term, and where the cycle of growth and harvest are sustained, the amount of carbon dioxide absorbed and released during this process is the same. This has lead to the widespread conclusion that the use of biomass as a fuel source is 'carbon neutral'.

Indeed, in the aforementioned life-cycle analysis conducted for OPG, a key assumption was made that "emissions of $CO_2$ resulting from the combustion of biomass are entirely balanced by the carbon incorporated during re-growth of the forest during the time period considered"[58] as long as the forest is sustainably managed. In other words, the study made an assumption of 'carbon neutrality'. While the claims of carbon neutrality may be valid over a longer time-frame, over a shorter time frame the claim requires some nuancing.

A study on the net effect of forest harvest on $CO_2$ emissions to the atmosphere has found that the time lag involved in a forest's regeneration and consequent uptake of the $CO_2$ released from burning wood biomass is such that a substantial, short-to medium-term "surge" of $CO_2$ is incurred.[59] In other words, the released $CO_2$ will be taken up by new growth, but only gradually, so that the full amount is not sequestered for a considerable period of time. Depending upon several variables, including the rate at which trees grow and the rate of harvest, this short- to medium-term "surge" will be problematic in a 390 ppm world.

The ECO raised a similar issue (along with other concerns relating to forest biodiversity) in our 2008/2009 Annual Report, as part of our review of MNR's Forest Biofibre Policy. The ECO pointed out that these shorter-term carbon increases will arise over the next few decades in the context of critical climate change 'tipping points'. In response to some of the concerns raised around biodiversity and forest productivity, the government has agreed that "assessing new policies and program initiatives on a lifecycle basis is an important advance that will inform CCAP measures."[60] It has not as yet provided a direct response to the concern about the carbon surge issue and its possible impact on tipping points or its implication for achieving the government's 2014 and 2020 GHG targets.

In summary, the ECO applauds OPG's initiative in conducting a life-cycle analysis on the use of wood pellets versus coal. The ECO believes that further work needs to be done, however, and sees a pressing need for further time-sensitive modelling of overall forest carbon levels, in order to assess the assumption of 'carbon neutrality' in the context of OPG's plans to use wood pellets as a fuel source.

**The ECO recommends that Ontario Power Generation complete a comprehensive assessment of the assumption of carbon neutrality with respect to plans to use biomass as a feedstock in its coal-fired generating stations.**

## 2.3 – Monitoring, Reporting and Verification Priorities

In our GHG Progress Report 2008/2009 the ECO indicated its strong support for the government's intention to include third-party verification of actual (*ex post*) GHG savings as they become available.

The goal of a GHG verification process should be to confirm whether a stated GHG claim has been accurately calculated and truthfully reported. In its CCAP Annual Report 2008-09, the government indicated that the plan's forward-looking emission reduction forecasts had been validated, and that the government planned to implement a third-party verification process beginning with its 2009-10 annual report. The ECO supported this commitment to "include third-party verification of actual measured savings as they become available."[61] In time, the ECO would expect the Ontario government's verification of actual CCAP results to complement the NIR as a source of GHG data. The ECO sees merit in using both sources of data going forward but does not expect the government to reconcile the two.

### 2.3.1 – Defining Terms

It is appropriate to begin a discussion about verification by defining terms. The term "verification" has multiple potential meanings to different users. In the context of GHG accounting, verification has a very specific meaning. However, it is often misused when applied to GHG accounting, perhaps because of its more frequent use in general parlance to refer simply to a "double check" on work completed.

In the context of GHG accounting, *verification* can be defined as a systematic, independent and documented process for evaluating greenhouse gas assertions (or claims) against agreed upon verification

criteria.[62] In contrast, *validation* is the process of confirming that the GHG accounting being done meets the users' needs.[63] GHG verification is therefore more complex than a "double check" of a GHG calculation. At the least granular level, verification can be said to consist of two components:

1. A management systems review (or conformity assessment), and
2. A quantification review (or materiality assessment).

The goal here is to ensure that the verification fundamentals are understood and will provide the intended users (the government, the ECO and the general public) with the requisite assurance.

### 2.3.2 – Verification Fundamentals

Verification fundamentals require that the following parameters be clearly understood: 1) objectives; 2) scope; 3) criteria; 4) level of assurance, and, 5) materiality. *Objectives* set the context and are the test for determining the relevance and veracity of a GHG reduction claim. *Scope* defines the what, where, when and who of the verification process. Ideally it also defines the how – how much latitude the verifier will be given to assess the original validator's assumptions. *Criteria* set the parameters and program rules to assist the verifier in determining overall compliance. *Assurance* levels are the client's confidence thresholds used to accept/reject a verifier's conclusions. And, finally, *materiality* is related to the error or uncertainty inherent in the reported data.

For a more detailed discussion of these fundamentals, refer to the box on this page and the next.

**Objectives**

The key *objective* of the CCAP's verification should be for the verifier to draw a conclusion that confirms or rejects that a claim regarding actual GHG performance (either for a specific CCAP initiative or for the entire Action Plan) is appropriate and true. More specifically, the objective should be to be able to make a statement on the "truth" of a CCAP initiative's conformance with criteria (GHG program rules) and with the validated plan (e.g., project design document), material changes (if any), controls for process and data quality, and accuracy.

**Scope**

There are four main dimensions to the *scope* of GHG verification. These define what precisely is being verified, where it is located, when it happened, and who will use the results of the verification. Scope is important for another reason in the context of the CCAP. Will the CCAP verifier be expected to review the assumptions and methodologies that were previously validated and found to be reasonable?[64] If not, the verifier is basically being asked to base its opinion of the accuracy of calculations and the truthfulness of the reporting on the validator's assurance which, even if it is high, is not a complete guarantee on the assumptions used. Since it is possible that the assumptions used could have material impacts on the GHG reductions of the initiatives, it would be useful to have them re-assessed by the verifier despite the assurance provided previously by the validator.

An additional consideration in the discussion of scope for the CCAP verification is whether an uncertainty assessment should be undertaken as part of the verification. Uncertainty assessments represent good practice in GHG verifications because uncertainties affect the GHG claims in two important ways: the verification *sampling plan*, in that high uncertainties would increase the potential risk of errors in the data itself, requiring the verifier to utilize a more thorough sampling plan to reduce the verification's detection risk to an acceptable level; and, the *materiality assessment*, in that high uncertainties may mean the GHG emissions calculated are far enough off their "true" values to cause the GHG claim to be materially incorrect.

**Criteria**

In the absence of the CCAP having clearly applicable program rules or *criteria* against which to determine compliance, the verification could proceed using the International Standards Organization's GHG quantification principles as general criteria, and the validated emissions modelling methodology for each sector as the detailed criteria.[65]

**Level of Assurance**

*Level of assurance* is the degree of confidence the intended user requires in a verification statement. Most GHG programs require a "reasonable" level of assurance (also known as a high level of assurance, or "positive assurance") for all verification activities. A reasonable level of assurance is distinguishable from lower levels of assurance in that there is more emphasis on detailed testing of GHG data and information supplied to support the GHG assertion. This is an area of considerable importance to the ECO. The reduction claims that are being verified in the government's annual CCAP reports and the verification statements that the government is expecting of the verifier should be well-defined before the verification process gets underway.

For example, the verifier should be able to provide assurance that each of the CCAP initiatives has an appropriate program management process and that the management process is working as intended. This requirement speaks directly to one of the key concerns the ECO raised in last year's progress report regarding governance: ideally, the assurance of the program management process would include a review of responsibility, authority and *accountability* roles within the government with respect to the CCAP initiatives.

**Materiality**

In typical GHG verification, *materiality* is generally either defined explicitly by the client or will be proposed by the verifier to its client based on the verifier's professional judgment and interpretation regarding the needs of the intended user. The latter approach was taken by the CCAP validator, who first proposed a threshold of 20 per cent for GHG reductions between the government's projections and validation projections for any given initiative, but then adapted this to be 5 per cent for the overall emissions reductions calculations because "a material issue identified for a single initiative, no matter how small in terms of GHG reductions, could prevent the [validator] from issuing an assurance statement covering the CCAP initiatives analyzed, which was the objective of the project."[66] A similar assessment and proposal will have to be made by the verifier.

### 2.3.3 – Verification of CCAP Initiatives Going Forward

The ECO recognizes that the verification of the correctness of the technical and process-orientated aspects of CCAP initiatives will likely be a unique assignment for a "typical" GHG verifier, with no prior examples or specific standards or protocols for the verifier to draw upon. This suspicion is supported by the government's validator, which noted in its October 2009 report that the validation of the CCAP initiatives was "the first known validation of estimates within a climate change mitigation process; hence, there are no directly relevant protocols."[67] Based on the discussion of verification fundamentals in Section 2.3.2, the following observations are offered to point the way to the development of a CCAP verification process.

**Process Controls**

Process controls may be the single most important aspect of a CCAP verification. For most initiatives the verifier is unlikely to have very much data on which to base their assessment, likely just the small number of data points provided by the lead ministry in the common reporting templates. Additionally, since the government's validator[68] did not appear to assess the controls on the data used in the projections, making such an assessment at the verification stage is that much more valuable. Requiring the verifier to assess the controls on the data used in the CCAP initiatives will also provide the assurance the ECO requested in our last progress report around controls (specifically, roles, responsibilities and accountabilities) in the data collection and emission reduction calculation processes.

**Scope**

An important consideration with respect to the scope of the CCAP verification relates to whether the verification should include a review of assumptions and methodologies that were previously validated and found to be reasonable. Since it is possible that the assumptions and methodologies used could have material impacts on the GHG reductions of the CCAP reduction initiatives, the government may wish to consider having them re-assessed by the verifier despite the assurance provided by the validator.

It would also be useful if the verification scope includes an uncertainty assessment (something that doesn't appear to have been done by the government's validator) to determine if the assumptions and methodologies introduce a material uncertainty into the calculation of GHG emission reductions from the CCAP initiatives.

**Sampling Plan**

The CCAP states that verification will be carried out on the actual results arising from a sample of initiatives. It will be important for the government to use a risk assessment approach to identify the initiatives that will be included in the verification. Since it is clear that most emission reductions over the short term are expected to come from the elimination of coal use for power generation, the ECO expects that the coal phase-out would be one of the initiatives verified. The government should require that a risk assessment be performed prior to each verification to take into account the future likelihood of initiatives, such as cap-and-trade, not proceeding.

**Initiative Implementation Rates**

One extremely important assumption of the CCAP, noted by both the validator and the ECO, is that

the plan's initiatives are assumed to have an implementation rate of 100 per cent (i.e., will be fully implemented). In verifying any initiatives, the implementation rate will therefore be an important factor for the verifier to assess. The results will provide assurance to the public and the ECO as to which initiative's implementation rates were quantified and presented appropriately, and it will indicate which initiative implementation rates require further work on the part of the government to quantify in a manner that is defensible.

**Additional Concepts Unique to a CCAP Verification**

One aspect of the CCAP that is different from a typical project or inventory is that it incorporates multiple "levels" of GHG emissions, removals and reductions information, each of which has its own associated GHG claim, and many of which are arrived at using different methodologies. It will be important for the purposes of transparency that the government reports on the development of other metrics wherever possible for the non-quantifiable CCAP initiatives - such-as the Next Generation Jobs Fund and the Ontario Emerging Technologies Fund - in order to track their contribution to the transition to a low-carbon economy. While the goals and criteria would have to be developed by the government, substantial guidance on a framework in which such criteria could be developed already exists.[69]

As indicated in our 2008/2009 Progress Report, the ECO believes that the verification process can assist in adjusting strategies for the design of new CCAP initiatives, referred to as "policy learning" and to ensure more transparent accountability for results, referred to as "performance management".[70] This reinforces the need for transparency in articulating both responsibilities and accountabilities for CCAP results.

**The ECO recommends that a CCAP verification process ensure that the responsibilities of key line ministries are clear and transparent and that accountabilities for results are clearly articulated.**

## 2.4 – Transportation and the Role of Road Pricing

Passenger vehicles represent 73 per cent of the GHG emissions from road transportation. As well, as noted in the ECO's Annual Energy Conservation Progress Report – 2009 (Volume One), transportation accounts for the highest demand for energy in the province and the "large and growing consumption of petroleum-based transportation fuels is unsustainable."[71] In this context, road transportation is an important sector on which to focus GHG reduction efforts.

### 2.4.1 – Defining Road Pricing

Road tolls were a fixture of Southern Ontario at the beginning of the 19th century and were used as a funding mechanism for early road construction.[72] Today, road pricing is usually positioned as a transportation demand management (TDM) tool that is used in many industrialized and developing countries to deal with a range of sustainability issues. Though rarely used in Canada,[73] international experience has shown that putting a price tag on roads can motivate[74] sustainable transport choices (transit, cycling, walking) while ensuring that road users pay more directly for multi-billion-dollar

transportation plans and infrastructure. In turn, these decisions help diminish traffic congestion, vehicle accidents, GHG emissions, air pollution, gasoline consumption and the need for expensive road expansion.

### 2.4.2 – Road Pricing Systems

Several types of road pricing systems have been proposed and/or implemented around the world. They are categorized as *priced highways*, *priced zones* and *fully priced road networks*. It is important to note that the original rationale for road pricing was first and foremost to alleviate traffic congestion and/or generate revenue for road building. More recently, however, road pricing has come to be seen as a way to fund transit expansion. Though environmental and safety (accident reduction) improvements are co-benefits, the ECO notes that these have rarely been cited as the main reasons for implementing road pricing systems.

**Priced Highways**

Priced highways include both conventional toll highways, such as Ontario's 407 Electronic Toll Road (ETR) plus high-occupancy/toll (HOT) lanes. A HOT lane gives drivers in single-occupant vehicles access to high-occupancy vehicles lanes (HOV lanes) upon paying a toll. Most systems now provide motorists with a choice of paying the toll manually or electronically (if they have obtained a transponder). Customizing conventional toll booths with electronic passes enables vehicles to maintain high speeds and avoid traffic back-ups, thus decreasing emissions to a certain extent.[75] However, because corridors can be up to 1,500 kilometres in length and traverse rural regions with different weather patterns, transportation authorities have not monitored priced highways for GHG emissions and criteria air contaminants (CACs), except at specific choke points within or near urban areas.

**Priced Zones**

Priced zones are created by establishing a cordon around congested urban areas as a way to: improve traffic flow; promote transit; decrease traffic accidents and reduce pollution. If a motorist chooses to enter the zone, they are charged by way of transponders or automatic number plate recognition cameras. Motorists can pay their bills in advance via internet or mail. Revenues are usually earmarked for transit and other transportation infrastructure. Three of the more prominent global cities that have implemented priced zones are London, Stockholm and Milan. Interestingly enough, Stockholm's Congestion Tax is the focal point of the city's goal to become a fossil-free city within the next 40 years.[76]

**Fully Priced Road Networks**

Fully priced networks (FPN) charge for the use of a region's entire road network, or all major highways and arterial roads. By limiting the number of non-priced roads, they tend to be more equitable since everyone pays – just as with the current system where everyone does not pay. While the only multi-vehicle FPN is Singapore's Electronic Pricing System, systems that only price heavy trucks exist in Germany, Switzerland and Austria. Successful pilot projects have been undertaken in Portland (Oregon), Puget Sound (Washington) and Eindhoven (Holland). Traffic modelling exercises have also been undertaken at the national level in England and through American universities (University of Iowa, University of Delaware) and transportation commissions.

### 2.4.3 – Lessons Learned

There is considerable evidence to indicate that road pricing can generate multiple benefits for users, providers, non-users and for the natural environment. What follows is a brief summary of the experiences of jurisdictions that have implemented road pricing instruments, discussed under the road pricing sub-headings from Section 2.4.2.

**Priced Highways**

The private company that now operates the 407 ETR has invested $200 million in upgrades since 1999. The highway boasts an accident rate that is half that of other provincial highways. Though the price per kilometre has increased to just over 21 cents during peak hours, the number of vehicle trips has also increased due to population and employment growth in the corridor, combined with the highway's reduced congestion, increased time savings and better overall service.[77] An independent study of the 407 ETR found that motorists saved 4 tonnes of carbon dioxide emissions annually plus 3 litres of gasoline and 33 minutes of time per trip when compared to drivers using Highway 7, a 6-lane public road with multiple intersections and traffic lights.[78]

Trip times can decrease substantially for those who opt for HOT lanes while opening up capacity for those who choose to remain in the general lanes. However, while there is anecdotal evidence to suggest HOT lanes can decrease emissions,[79] the fact that capacity is actually increased suggests there may be no net change in emissions. Further, studies have demonstrated that GHG and CAC reductions and new transit monies from HOT lanes are very limited when compared with those achieved through more comprehensively priced zones and networks.[80] Since general lane capacity is not removed from the highways where they exist and net revenues are generally earmarked for transit, HOT lanes tend to gain public support more readily than other road pricing options.[81]

**Priced Zones**

Most motorists who enter the London Congestion Charge (LCC) zone on weekdays between 7:00 and 18:00 pay a flat rate equivalent to CDN$12.30[82] to enter the zone – an area encompassing about 41 square kilometers[83] in Central London. With the addition of 300 new buses to its fleet at the time the congestion charge was launched, there has been a traffic reduction of 25 per cent (70,000 less vehicles/day) to the central business district with no corresponding decline in overall trip numbers – 50 to 60 per cent of the former trips shifted to transit and cycling increased by 90 per cent. In the more residential western zone, there was an initial 19 per cent traffic reduction (30,000 fewer vehicles) but it has returned to pre-LCC levels largely due to development, utility projects and capacity reductions. These traffic reductions, combined with other policies related to green vehicles and low-emission zones, resulted in a 16 per cent decline in GHG emissions across the entire LCC zone. Emissions of NOx (nitrogen oxides) and $PM_{10}$ (particulate matter less than ten microns in diameter) also decreased by 8 per cent and 7 per cent respectively.[84]

To date, the Stockholm Congestion Tax has decreased GHG emissions by 25,000 metric tonnes, 12 per cent of which is due to a sharp escalation in the alternative vehicle fleet (from 3 to 15 per cent)[85] and a surge in cycling (15 per cent).[86] There has also been an improvement in air quality. With a goal of reducing traffic a further 30 per cent and achieving a 75 per cent modal share for transit (up from 60 per cent today), some of the revenues are being invested in a new suburban tramline, commuter train tunnel, ring road and

a bypass tunnel. With 75 per cent of Stockholm residents willing to make a personal sacrifice to mitigate climate change and use a mix of travel modes for their daily needs, the city is on the right path to meet its "fossil-free" objective.[87]

**Fully Priced Road Networks**

In 1975, Singapore introduced a London-styled cordon area system or Area Licensing Scheme (ALS) and in 1998 replaced this system with its current electronic road pricing system. Congestion initially fell by 45 per cent under the ALS, and fell a further 15 per cent once the full electronic pricing system was in place.[88] Accident rates declined by 25 per cent. As a result, average speeds almost doubled from 18 km/hour to 34 km/hour while transit use increased by 20 per cent. This caused capacity and delay problems due to bus overloading so a state-wide mass rapid transit (heavy rail) system was built in 1982, seven years after the implementation of the cordon area system. Today, out of a total of 7.7 million daily trips, 50 per cent of commuters use transit, 36 per cent travel by car and 12 per cent use taxis.[89]

The ALS has resulted in a reduction of 176,400 pounds of $CO_2$ and 22 pounds of particulate matter.[90] Recent figures since the full electronic pricing system replaced the ALS put $CO_2$ reductions at 80 per cent. External studies have suggested, however, that a proper cost-benefit analysis was not undertaken, air quality determinants were not adequately controlled for and the monitoring period was not long enough.[91]

### 2.4.4 – Implications for Ontario

There is considerable uncertainty as to what extent the "lessons learned" described in the previous section would have application in Ontario. The land use patterns, densities and cultural exposure to these road pricing systems may be unique to these jurisdictions. Many of the examples deal with predominantly high density urban forms and, as such, would only have application in larger Ontario centres where realistic transit alternatives exist. Based on 2006 Census data, Ontario's population is expected to grow by nearly 5 million by 2036, from 13 million in 2008 to almost 18 million by 2036. Projected to be the fastest growing region of the province, an additional 3.1 million people are forecast for the Greater Toronto Area (GTA) alone, where such transit alternatives will be available.[92]

The government has set in place plans that have the potential to reduce GHGs associated with personal transportation. The current initiatives in these plans, if implemented fully, will improve access to public transit and result in fewer vehicle kilometers travelled (VKT) per capita. However, it has been noted that the population increases noted above will likely lead to an increase in total VKTs – and GHGs – due to an increase in the total number of drivers.[93]

The ECO agrees that a more aggressive transit modal share target – the proportion of trips taken by transit – must be the cornerstone of any serious effort to reduce GHGs associated with personal transportation. In the Greater Golden Horseshoe region, for example, modelling done by Metrolinx indicates that by 2031 there will be a transit modal share of 24.2 per cent.[94] Metrolinx estimates that this will increase to 26.2 percent if the recommendations in The Big Move are fully implemented.[95] The Pembina Institute has concluded that it should be possible to increase Metrolinx's transit modal share target to a 10 per cent improvement by 2031 (to 34.2 per cent) through the introduction of such measures as a regional fuel

tax, a cap on the number of parking spaces and the introduction of road tolls (including more HOT lanes and congestion charges).[96] The ECO agrees that a more aggressive transit model share target by 2031 is challenging but achievable.

Metrolinx is required to produce an investment strategy by 2013 on options to finance future transit expansion. The analysis will include a review of what other major cities around the world are doing – including the role that road pricing may play – to fund transit. In light of the recent announcement of funding delays of $4 billion to Metrolinx's plans, the need to accelerate the delivery date for this options report is obvious. Further, the Metrolinx report would be wise to consider in its terms of reference a requirement to measure the GHG reduction potential of improving transit's modal share target by 2031.

**The ECO recommends that Metrolinx develop planning scenarios and interim dates to achieve a more ambitious transit modal share target for 2031.**

## 2.5 – Pricing Carbon in the Economy

A growing number of government, environmental and private sector sources are stressing the crucial need for market-based policies and regulations to "put a price on carbon".[97] This position is based on two key principles: 1) the need to capture the environmental externalities associated with the costs of burning fossil fuels and, 2) the need to send the right price signals into the marketplace to stimulate consumer demand for and private investment in cleaner forms of energy, thus hastening the transition to a low-carbon economy.

In January 2010, the *Environmental Protection Act* (*EPA*) was amended by the *Environmental Protection Amendment Act* (*Greenhouse Gas Emissions Trading*), *2009* (*EPAA*). While not yet fully in force, amendments made to section 176.1 allow the Ontario government to develop market-based regulations to control the release of greenhouse gases. The *EPAA* sets the rules governing how the allowances[98] that underpin cap-and-trade (also referred to as "tradable permit") systems will be created, allocated, traded, reported and verified.

The ECO notes and supports the manner in which the province has kept its options open in implementing this enabling legislation in recognition of the continued uncertainty surrounding the climate change policy landscape in North America. The ECO endorses the government's clear intention in the amended *EPA* to reduce greenhouse gas emissions "without being limited to emissions trading".[99]

The policy challenge can be summarized as follows: should GHG *quantities* be regulated (via emission caps and tradable permits) or should GHG *prices* be regulated (via a carbon levy or tax)?[100] Can both be done? And, a related question; which is best at getting a price signal into the economy while also contributing to the achievement of the government's GHG reduction targets?

The ECO supports government efforts to put a price on carbon emissions, but remains agnostic on the merits of these two policy instruments (a cap and/or a tax), whether used in isolation or in combination with each other. And, while the ECO recognizes that consideration of a carbon tax is often referred to as the "third rail" of federal and provincial politics, other jurisdictions with similar standards of living to Ontario are in various stages of implementing a carbon tax.[101] The ECO also notes that the Ontario government's public consultation process on carbon pricing to date has focused only on one policy instrument: cap-and-trade. There is a need for a reasoned and balanced public discussion comparing and contrasting emissions trading and a carbon tax in terms of their efficacy in ensuring carbon price discovery in the economy while reducing GHG emissions.

The following discussion provides an overview of both pricing instruments from the standpoints of: 1) emissions certainty and price certainty; 2) administrative oversight; 3) transparency; and, 4) implications for the transition to a low-carbon economy.

### 2.5.1 – Emissions Certainty and Price Certainty

Under a cap-and-trade system, a cap is established, measured in tonnes of $CO_2e$/year, and a fixed number of permits to emit are distributed, either by auction or free-of-charge. Over time, the cap is reduced. The caps are usually negotiated with industry and, ideally, are set on the basis of a combination of industry benchmarks and current best practices.[102] They should not be based on historical emissions (which would in essence be rewarding inaction by laggard industries).

A tradable permit system fixes the level of emission reductions, via the cap, but leaves the price per tonne up to the laws of supply and demand. So, "benefit certainty" (i.e., the *quantity* of GHG reductions mandated by the cap) is achieved at the expense of "price certainty". This price uncertainty is a key area of concern for many large companies.[103] It is expected that a certain degree of price volatility is necessary to ensure that carbon markets work even with so-called "price collars" that provide a safety valve on carbon prices.[104]

In contrast, a carbon tax is a price-based mechanism that fixes the price per tonne based on the carbon content of each fossil fuel but does so at the expense of certainty about when and where emissions reductions will occur. So, "price certainty" is achieved at the expense of "benefit certainty". The National Round Table on the Environment and the Economy (NRTEE) has concluded that an effectively designed carbon pricing system (via either a tradable permit system or a carbon tax) should be able to provide a transparent carbon price signal while also achieving some certainty on emission reduction benefits.[105]

While a tradable permit system can lead to price volatility, a carbon tax sets a stable and predictable price for carbon, providing less risk and uncertainty for households and businesses making GHG reducing investment decisions.[106] Further, assuming revenue neutrality,[107] a pool of funds can be created to provide tax relief to trade-exposed industries and disadvantaged households and to invest in research and development into low-carbon technologies. Auction revenues under a cap-and-trade system would generate a similar pool of funds and, depending on the market price and percentage of the cap auctioned, could generate similar (or higher) fund pools.

### 2.5.2 – Administrative Oversight

Carbon trading systems require the development of new institutions to operate effectively including registries, exchanges, brokerages and related legal, reporting and verification services. Ideally, these institutions provide efficient and transparent markets where companies can buy and sell permits/allowances and carbon offsets[108] while obtaining transparent pricing information on carbon. Key considerations include rules for: 1) distributing allowances (by auction or free-of-charge); 2) setting reporting requirements (which Ontario has done through the enactment of O. Reg. 452/09 – Greenhouse Gas Emissions Reporting, made under the *Environmental Protection Act*);[109] 3) establishment of enforcement mechanisms; 4) setting of market requirements around banking, borrowing, offsets, price caps and floors; and, 5) linkage or integration with other systems.

**The Western Climate Initiative**

To ensure the province is on the same page and working in tandem with cap-and-trade developments elsewhere in North America, Ontario joined the Western Climate Initiative (WCI) in July 2008,[110] a collaboration of seven U.S. states and three other Canadian provinces[111] working towards a common framework for the reporting of GHGs and the design and implementation of a tradable permit system. The WCI's proposed emission reduction goal for its members is less onerous than Ontario's (a 15 per cent economy-wide reduction from 2005 levels by 2020, compared to Ontario's 15 per cent reduction from 1990 levels by 2020).

The stated intention is for the WCI trading platform to be up and running by January 1, 2012 but initially only covering the electric power sector plus combustion sources from large industrial and commercial entities and industrial process emissions.[112] However, starting in 2015, sector coverage will increase to include residential, commercial and industrial fuel combustion and transportation fuel use.[113] This will effectively capture about 90 per cent of WCI member emissions.

The WCI's recommendations regarding the distribution of allowance or permits is that member jurisdictions should sell through auction a minimum of ten per cent of cap allowances starting in 2012 ramping up to at least 25 per cent through auction by no later than 2020. In other words, over the 2012 to 2020 period, the overwhelming majority of permits – up to 90 per cent starting in 2012 and up to 75 per cent by 2020 – could be distributed to emitters within WCI member jurisdictions free of charge.

Given these underlying challenges associated with cap-and-trade systems, several energy industry stakeholders plus non-governmental organizations (NGOs) in Ontario have indicated a preference for a carbon tax.[114] Mechanisms do exist, in theory, to collect carbon taxes. However, significant administrative details would still need to be addressed including provincial and federal tax harmonization, the administration of revenue pools and consumer and industry tax rebates. Measures would also be needed in response to import/export tax implications, also referred to as "border adjustment mechanisms".[115]

There would also be a need for broader tax system reform if revenue neutrality is a goal. Tax reforms may include offsetting reductions in personal, corporate and small business tax rates, as well as protection for

low-income households (e.g., through a 'carbon tax credit' as British Columbia has done). A challenge will be to estimate and track GHG reductions associated with a carbon tax versus business-as-usual (BAU) but this is less of a concern now that O. Reg. 452/09 is in place.

### 2.5.3 – Transparency

While both a carbon tax and tradable permit system achieve the same goals in theory, it has been suggested that a carbon tax would be simpler to implement, more transparent, and less susceptible to political manipulation and "market malfeasance".[116] Concerns about gaming and lack of transparency were raised before Ontario's Standing Committee on General Government (SCGG) in November 2009 regarding the province's proposed legislative changes to the *EPA* by the *EPAA*. Several large energy companies, associations and NGOs attending the committee hearings expressed a strong preference for a carbon tax, noting that, as demonstrated in British Columbia, such a pricing instrument can provide a predictable cost of carbon, thus making it easier for all consumers of fossil fuels to "make decisions about ... investments to reduce emissions."[117]

Cap-and-trade was described by one energy association representative at the SCGG hearings as having the potential for "abuse and gamesmanship."[118] Concern was also raised regarding the impacts of market speculation on carbon price volatility, noting that the actions of emissions allowance brokers and traders "aimed at trading on price volatility can too easily take the emphasis away from the real task of reducing emissions."[119]

If the majority of allowances under a cap-and-trade system are allocated free of charge, GHG compliance costs are set at a more manageable level for industry but the externality cost is not captured and the sought-after price signal is obscured.[120] Auctioning does have the potential for government revenues to be redirected, via the tax system, to consumers or to support clean technology developments but the price signal is still obscured even if the cost of compliance is passed on to the consumer. Under a carbon tax, all consumers of fossil fuels (including fuels used in the production process) would pay, based on the carbon content of the fuel they use. (For a summary of how British Columbia's carbon tax is administered, refer to the sidebar story.)

Can both work together? Where both a carbon tax and a tradable permit system exist (e.g., in the United Kingdom),[121] care must be taken to avoid industry being caught under both. This is, in fact, how the B.C. system will work. Like Ontario, B.C. is a member of the Western Climate Initiative (WCI – see sidebar story on the previous page) and, assuming the WCI cap-and-trade system is launched on January 1, 2012, B.C. plans to exempt from the carbon tax those companies and industries that are captured under the WCI tradable permit system.

As noted above, to the extent that an industry or company may be able to incorporate the costs of compliance under a tradable permit system into the price of its goods and services, it can be argued that the cost of carbon is not fully transparent. On the other hand, a carbon tax sends a very clear and unambiguous price signal to all consumers of fossil fuels because it is usually published as a tax schedule showing what the price impact is by fuel type and the schedule for carbon tax increases over time.[122]

### 2.5.4 – Implications for Transitioning to a Low-Carbon Economy

A central issue in the development and implementation of a carbon pricing system in Ontario concerns how the resulting policies and provisions will affect the province's economic competitiveness. As noted earlier, there is considerable uncertainty surrounding the climate change policy agenda in North America. While the Canadian federal government has essentially ceded the details of its climate change policy plans to Washington, there is no clear indication how, when or if the U.S. Congress will move forward on the climate change file.[123]

In the face of this uncertainty, Ontario is in a good position and has kept virtually all of its policy options open. While the reporting and trading architecture being contemplated in the U.S. is being driven largely by power sector emissions which represented about 35 per cent of total U.S. GHG emissions in 2008,[124] the situation in Ontario is significantly different, where only about 14 per cent of the province's GHGs were attributed to the power sector in 2008.[125] Further, as noted above, the Ontario government expects to have reduced its total GHG emissions by a further 10 per cent by 2014, compared to 2008, through the phase-out of coal use at its remaining coal-fired power plants.

It has been argued that free allocation of the majority of permits during the early stages of a cap-and-trade regime, as well as access to "credible offsets", are crucial cost-containment provisions that Ontario companies will need in order to manage the transition to a low-carbon economy.[126] The ECO questions this focus on near-term cost-containment. It reflects a short-term emphasis on the next quarter's balance sheet at the expense of the longer-term financial health of the company. It also ignores the equally important issue of cumulative effects and the broader costs to society from GHG emissions.

The NRTEE recognizes the competitiveness issues associated with imposing too high an initial compliance cost on Canadian industry, but recommends that 100 per cent of permits be auctioned by no later than 2020.[127] Others have pointed out that 100 per cent auctioning as early as possible eliminates the administrative burden (and political interference) associated with who gets "free" allowances while also recognizing and rewarding companies that took early action, "because those that have already reduced their emissions have fewer allowances to buy."[128]

A PriceWaterhouseCoopers study suggests that, over time, it will usually be cheaper for a company to invest in new, lower-emitting technology up-front, rather than relying primarily on trading and the acquisition of offsets for compliance purposes.[129] A company that invests in new technology to lower its carbon footprint (either for compliance purposes or as a hedge against stricter caps in the future) may only have to do this once during its first compliance period (e.g., from 2012 to 2020 under WCI rules) to stay under its initial cap, and the emission reduction benefits from this investment will accrue for the life of the equipment. On the other hand, a reliance on offsets and tradable permits for compliance purposes requires that these instruments be purchased in full *every year* to ensure the company meets its compliance obligations.

The key question is: Should Ontario move forward on pricing carbon in the economy if the U.S. or WCI does not proceed or should Ontario wait until the U.S. takes the initiative? Some observers[130] have stressed that waiting for policy certainty at either the federal (Ottawa/Washington) or regional (WCI)

level could jeopardize the early development of the low-carbon economy envisaged by the *Green Energy and Green Economy Act* (*GEGEA*) and identified as one of the key policy objectives of Ontario's Climate Change Action Plan.[131]

Finally, as discussed in Section 2.1 of this report, there is the growing realization that current levels of GHGs in the atmosphere and the oceans are seriously interfering with the planet's climate system. The scientific consensus is that the target concentration for equilibrium in the atmosphere should be 350 ppm, a level that has already been exceeded. As such, the need to put a price on carbon becomes more urgent. This reinforces the ECO's position that Ontario's current GHG reduction targets are modest at best and that all policy instruments, including an aggressive and transparent carbon pricing signal, are needed – and needed soon – if Ontario is committed to showing true leadership in climate change policy.This leadership must include broader public discourse concerning how best to price carbon in the economy. The need for a transparent carbon price signal has been noted earlier by both industry and the broader public with some favouring a carbon tax. While cap-and-trade is one way to price carbon in the marketplace, it is not the only way.

**The ECO recommends that the Ontario government undertake a formal public review to compare emissions trading and a carbon tax in terms of their efficacy in providing a transparent price signal to the economy.**

While several countries within the European Union have implemented carbon taxes, very few jurisdictions within North American have done so. In 2008, British Columbia became the first jurisdiction in Canada to implement a broad-based tax on carbon-based fuels, including gasoline, diesel, natural gas, heating fuel, propane and coal. Also included are peat and tires when burned to produce energy or heat. The burning of these fossil fuels represents approximately 77 per cent of the province's total GHG emissions.[132] In general, the tax is applied to all fuels that are purchased, transferred or used within, or brought into, the province.

The tax rate is based on the amount of carbon dioxide equivalent ($CO_2e$) emissions released by each fuel and is designed to increase on an annual basis. As of July 1, 2009, the rate was $15 per tonne of $CO_2e$ and will increase by $5 per tonne to $30 by 2012. Future prices have not yet been established, and the limited time horizon allows increasingly stringent prices to be applied if necessary in four years' time.[133]

By starting at a relatively low rate, and clearly outlining future increases, citizens and businesses are provided with time to adjust their patterns of fuel consumption in order to reduce the amount paid. For individuals, the main impact of the tax relates to transportation and heating costs.[134] For businesses, the main impact relates to transportation, building heating, and fuels used for industrial processes.[135]

To provide transparency, future tax increases by fuel type are published. For example, the price impact of the tax on a litre of gasoline was 3.33 cents per litre (¢/litre) between January and June 2010. By 2012, this amount is scheduled to increase to 6.67 ¢/litre. For heavy fuel oil, which has a higher carbon content, the rate will increase from 4.73 ¢/litre in 2010 to 9.45 ¢/litre by 2012.

A key element of B.C.'s carbon tax is its *revenue neutrality*[136] which means that reductions must be made to other taxes in order to fully return to taxpayers the amount generated by the carbon tax. In order to achieve neutrality, the government reduced personal and business taxes. Personal income taxes, for example, have been reduced by 5 per cent on taxable income up to $70,000.[137] For general corporate income taxes, the rate was lowered from 12 per cent to 11 per cent in July 2008, with a further decrease of one per cent scheduled for January 2011. For small businesses, the income tax rate was reduced from 4.5 per cent to 3.5 per cent in July 2008 and is scheduled to drop to zero by April 2012.[138] To provide transparency around revenue neutrality, the government is legally required to present an annual plan outlining the manner by which carbon tax revenues will be balanced by a corresponding tax reduction.

According to the B.C. government, more money has been returned to taxpayers in the form of other tax reductions to date than has been collected through the carbon tax. Rather than being used as general revenue, the monies collected through the carbon tax are redistributed for various purposes. Along with lowering personal and corporate income taxes, the revenues are used to fund clean energy development.[139] As well, a portion of the revenue is returned as a grant to communities that have pledged, and are making progress, to become carbon-neutral by 2012.[140] To ensure that the tax is not regressive, a refundable 'Climate Action Tax Credit' was established to assist low income individuals and families. The tax credit is indexed to meet provincial inflation and in July 2011, will increase by 10 per cent.[141]

The main goal of the carbon tax is to reduce overall GHG emissions and it represents a key initiative to meet B.C.'s target to reduce emissions 33 per cent over 2007 levels by 2020. It has been estimated that the tax will result in an annual reduction of up to 3 Mt of $CO_2e$ emissions. While the tax is not the only measure taken by British Columbia to reduce its GHG emissions, it represents a key tool in the province's GHG reduction toolkit.

# 3 – Conclusions and Recommendations

The main intent of this ECO report has been to cast a wider net in terms of policy areas in need of further study and elaboration. In broadening the climate change policy agenda, the ECO hopes that the government will engage the public in an expanded consultation on the promise and challenges of achieving greenhouse gas reductions in the Ontario economy and in society at large. The public's participation in this effort is crucial if the government has any real hope of meeting its existing Climate Change Action Plan GHG targets. This is not just the government's plan; nor is it one ministry's. It must be seen as the province's action plan and it must involve all stakeholders in its on-going design, implementation and review. Time is of the essence ... and we can ill-afford uncertainty and delay. "Action delayed is effectively results denied."[142]

**The ECO recommends that the Ontario government undertake a formal public review of its CCAP GHG targets in light of scientific evidence indicating concentrations of GHGs in the atmosphere are unacceptably high.**

**The ECO recommends that Ontario Power Generation complete a comprehensive assessment of the assumption of carbon neutrality with respect to plans to use biomass as a feedstock in its coal-fired generating stations.**

The ECO recommends that a CCAP verification process ensure that the responsibilities of key line ministries are clear and transparent and that accountabilities for results are clearly articulated.

The ECO recommends that Metrolinx develop planning scenarios and interim dates to achieve a more ambitious transit modal share target for 2031.

The ECO recommends that the Ontario government undertake a formal public review to compare emissions trading and a carbon tax in terms of their efficacy in providing a transparent price signal to the economy.

# Endnotes

[1] Environment Canada, National Inventory Report – Greenhouse Gas Sources and Sinks in Canada 1990-2008, Part 3, 73.

[2] Environmental Commissioner of Ontario, Annual Greenhouse Gas Progress Report 2008/2009: Finding a Vision for Change, 13.

[3] Government of Ontario, Climate Change Action Plan Annual Report 2008-09, 5.

[4] Ibid., 13.

[5] This represents the total emissions quantified for key GHG reduction initiatives as per the Government of Ontario in Ibid., 63-65.

[6] Ibid., 7.

[7] See supra note 1. Greenhouse gases have different global warming potentials and so to allow these gases to be compared, the Intergovernmental Panel on Climate Change compares all GHGs to carbon dioxide. This results in a total being stated as $CO_2$ equivalent ($CO_2$ eq). For brevity in this report, we have chosen to refer to GHG quantities in Mt (megatonnes).

[8] Ibid.

[9] Ibid.

[10] For the purposes of our calculations, pipelines are captured under 'industrial emissions' rather than 'transportation' as reported in the National Inventory Report.

[11] Environmental Registry Number 010-9766.

[12] Pollution Probe, Submission to the Federal Government on Bill C-30. February 6, 2007, 3.

[13] Environment Canada, "Canada and the United States Announce Common Standards for Regulating GHG Emissions from New Vehicles," News Release, April 1, 2010.

[14] Ibid.

[15] See supra note 3, 64.

[16] Metrolinx, Development of a Regional Transportation Plan for the Greater Toronto and Hamilton Area.White Paper #2, May 2008, 39.

[17] See supra note 1, 112. Freight transportation includes heavy-duty gasoline and heavy-duty diesel vehicles.

[18] Mike De Souza, "Canada to crack down on heavy-truck pollution," Canwest News Service, April 15, 2010.

[19] Government of Ontario, Ontario Budget 2010: Open Ontario, Ontario's Plan for Jobs and Growth, 53.

[20] See supra note 1, 112.

[21] Ibid.

[22] See supra note 19, 81.

[23] See supra note 1, 112.

[24] At the provincial level, emissions coming from ammonia production are included as Industrial Processes in the National Inventory Report.

[25] Independent Electricity System Operator, "Electricity Figures Show Record Levels of Hydroelectric Power," News Release, January 12, 2009.

[26] Ontario Power Generation, Power Generation, http://www.opg.com/power/ (May 17, 2010).

[27] These facilities have a lower emissions profile compared with fossil-fuel power plants.

[28] Ontario Power Generation, 2008 Sustainable Development Report, 12.

[29] Ontario Power Authority, Ontario's Feed-in Tariff Program Backgrounder, April 8, 2010.

[30] See supra note 3, 64.

[31] See supra note 2, 21.

[32] See supra 19, 74.

[33] Ibid.

[34] Environmental Commissioner of Ontario, Annual Report 2008/2009: Building Resilience, 51.

[35] Subject to minor change, depending on recalibration of the reference gas mixtures used, and other quality control procedures.

[36] O. Hoegh-Guldberg, et al., "Coral Reefs Under Rapid Climate Change and Ocean Acidification," Science, 318 (December 14, 2007): 1737-1742. Ben I. McNeil and Richard J. Matear, "Southern Ocean acidification: A tipping point at 450-ppm atmospheric CO2," PNAS, 105(48) (December 2, 2008): 18860-18864. Long Cao and Ken Caldeira, "Atmospheric $CO_2$ stabilization and ocean acidification," Geophysical Research Letters, 35 (2008): doi:10.1029/2008GL035072.

[37] A state that it is acknowledged would not be reached for many decades.

[38] James Hansen, *Storms of My Grandchildren* (New York: Bloomsbury, 2009).

[39] The albedo of an object is a measure of how strongly it reflects light from light sources such as the sun. It is a more specific form of the term reflectivity. Ice, especially with snow on top of it, has a high albedo and so most sunlight hitting the surface bounces back towards space. Water is much more absorbent and less reflective. So, if there is a larger area of water, more solar radiation is absorbed by the ocean than when ice dominates.

[40] See supra note 3, 63.

[41] See supra note 28, 37.

[42] Ibid.

[43] Ministry of Energy, Shareholder Directive - Addressing Carbon Dioxide Emissions from the Use of Coal at Coal-Fired Generating Stations, May 15, 2008.

[44] See supra note 28, 14.

[45] Ontario Regulation 496/07 – Cessation of Coal Use – Atikokan, Lambton, Nanticoke and Thunder Bay Generating Stations, made under the *Environmental Protection Act*.

[46] Even if the government elected to proceed immediately with a new build nuclear facility, it would not be commissioned by 2014.

[47] Ontario Power Generation – Presentation to the Environmental Commissioner of Ontario, February 24, 2010. Atikokan has one coal-fired unit, Lambton has four, Nanticoke has eight and Thunder Bay has two. See supra note 28, 37.

[48] Ontario Power Generation, Biomass Energy, www.opg.com/power/fossil/biomass.asp (May 19, 2010).

[49] Yimin Zhang, et al., "Life Cycle Emissions and Cost of Producing Electricity from Coal, Natural Gas, and Wood Pellets in Ontario, Canada, " *Environmental Science & Technology*, 44:1 (2010): 540.

[50] Ibid.

[51] See supra note 47.

[52] Ibid.

[53] On a kilowatt-hour basis.

[54] See supra note 49, 541.

[55] Ibid., 543.

[56] Ibid.

[57] See supra note 47.

[58] See supra note 49, 539.

[59] B. Schlamadinger and G. Marland, "Net effect of forest harvest on $CO_2$ emissions to the atmosphere: a sensitivity analysis on the influence of time." *Tellus*, 51B (1999), 314-325.

[60] See supra note 3, 30.

[61] See supra note 2, 31.

[62] International Organization for Standardization, ISO 14064-3:2006, Greenhouse gases — Part 3: Specification with guidance for the validation and verification of greenhouse gas assertions (2006).

[63] In the context of the production of a product, validation ensures that the right product was manufactured. Verification, on the other hand, ensures that the product was manufactured right.

[64] For example, in our Annual Greenhouse Gas Progress Report 2008/2009, the ECO expressed concern regarding the assumption contained within the Government of Ontario's Climate Change Action Plan Annual Report 2008-09 that all initiatives will be fully implemented, achieving 100 per cent of their potential. The ECO felt this was an "inherent risk that was not analyzed by the validation consultant."

[65] While it is possible to use the validated methodologies as criteria, it would still be appropriate to assess the continued applicability of the methodologies' assumption as part of the verification scope.

[66] E.H. Pechan & Associates, Inc., *Ontario Climate Change Action Plan Greenhouse Gas Reduction Initiatives Validation Report – Final* (October 2009), 4.

[67] Ibid.

[68] Ibid.

[69] Examples include: Risk Management and Accountability Frameworks (RMAFs); exisiting best practices for accountability and risk management in grant and contribution programs developed by organizations like the Canadian Institute; and the Treasury Board of Canada Secretariat's new Evaluation Policy, which offers guidance on establishing an evaluation framework for gathering evaluation (i.e., audit or verification) evidence that can be used to support policy and program improvement, expenditure management, decision making, and public reporting.

[70] See supra note 2, 26.

[71] Environmental Commissioner of Ontario, Annual Energy Conservation Progress Report – 2009 (Volume One): Rethinking Energy Conservation in Ontario, 33.

[72] Road pricing actually harkens back to the days of Socrates and kings and queens when the construction and upkeep of roads was paid for by those who travelled on them. The British brought the toll road idea to Ontario in the early 1800s and for over a century all roads here were built and maintained by private entrepreneurs who charged for their use. Yonge Street, Dundas, Kingston Road and Lakeshore Road were all tolled but by 1926 all had become public roads. Ontario Ministry of Transportation, Footpaths to Freeways: The Story of Ontario's Roads, 1984.

[73] Approximately 200 highway kilometers are tolled in Canada including Ontario's 407 Electronic Toll Road and Nova Scotia's Highway 104 Toll Highway. Sixteen bridges and one tunnel also have tolls.

[74] United States Department of Transportation, Transportation's Role in Reducing U.S. Greenhouse Gases – Volume 1: Synthesis Report (April 2010), 3-18.

[75] R.W. Groneman, New York State Thruway Authority, Telephone conversation with Martin Collier, April 6, 2010.

[76] Martin Collier, 2010, personal communication.

[77] Imad Nassereddine, "407ETR: Gaining User Acceptance," Transport Futures 2009 Road Pricing and Public Acceptance Workshop (Toronto, Ontario), November 12, 2009.

[78] Ibid.

[79] Ken Buckeye, Minnesota Department of Transportation, e-mail correspondence with Martin Collier, March 30, 2010.

[80] Patrick Decorla-Souza, "Gaining Public Acceptance for Road Pricing: Experience in the United States," Transport Futures 2009 Road Pricing and Public Acceptance Workshop (Toronto, Ontario), November 12, 2009.

[81] Ken Buckeye, "Road Pricing Experience in Minnesota, USA," Transport Futures 2009 Road Pricing and Public Acceptance Workshop (Toronto, Ontario), November 12, 2009.

[82] The basic central zone levy will increase to $15.40 CDN in December 2010.

[83] For reference, 41 $km^2$ represents about six per cent of Toronto's current size. The former City of Toronto was just over double this size at 97.15 $km^2$.

[84] Transport for London, "Eliminating Gridlock with Intelligent Traffic Systems," Presentation to Urban Transportation Summit (Toronto, Ontario), March 3, 2010.

[85] Alternative vehicles also receive parking fee exemptions.

[86] Cycling may have increased due to a combination of the congestion tax, new infrastructure, economic cycles and/or weather patterns.

[87] Gunnar Söderholm, "The Stockholm Congestion Tax: A Case Study," Presentation to Transport Futures 2009 Road Pricing and Public Acceptance Workshop (Toronto, Ontario), November 12, 2009.

[88] Martin Collier, A Scan of Road Pricing Options, Prepared for the Environmental Commissioner of Ontario, May 19, 2010.

[89] Eddie Lim, (2006) Electronic Road Pricing: Singapore's Experience, http://www.itdp.org/documents/5837_Eddie_Lim_Singapore_Pricing.pdf; and Eddie Lim Sing Loong, (undated) Electronic Road Pricing: The Singapore Way http://www.comp.nus.edu.sg/~wongls/icaas-web/links/NLB/innovsymp06/eddie-erp-talk.pdf (May 20, 2010).

[90] Environmental Defense Fund, Singapore: A Pioneer in Taming Traffic (2007), http://www.edf.org/article.cfm?contentID=6166 (May 20, 2010).

[91] A.T.H. Chin (1996), "Containing air pollution and traffic congestion: Transport policy and the environment in Singapore," Atmospheric Environment 30 (5), 787–801.

[92] Ontario Ministry of Finance, 2009. Ontario Population Projections, 2008-2036, Queen's Printer, Ontario.

[93] Cherise Burda, et al., Driving Down Carbon: Reducing GHG Emissions from the Personal Transportation Sector in Ontario, Pembina Institute (2010).

[94] Metrolinx, The Big Move Modelling Backgrounder, December 2008, 8. Metrolinx indicates that the current transit mode split is 18 per cent.

[95] Ibid.

[96] See supra note 93, 25.

[97] For example, British Columbia has put a price on carbon by enacting a Carbon Tax Act in May 2008. In its report, Getting to 2050: Canada's Transition to a Low-emission Future, the National Round Table on the Environment and Economy concluded that the "most effective and efficient policy that would result in deep GHG emission reductions is a market-based policy, such as an emissions tax, a cap-and-trade system, or a combination of the two." The head of the Canadian Gas Association recently indicated that putting a price on carbon is inevitable and urged industry to adapt. http://www.cga.ca/newsroom/newsroom.htm (May 14, 2009).

[98] Allowances, also referred to as "permits", are discrete units, measured in tonnes (where one permit equals one tonne of $CO_2e$ emissions) that are tracked through a registry and identified by way of a serialized certificate.

[99] Environmental Protection Act, s. 176.1 (1), 2009, c. 27, s. 2 (1).

[100] Mark Jaccard, Designing Canada's Low-Carb Diet: Options for Effective Climate Policy (C.D. Howe Institute and Bennet Jones LLP, November 28, 2007).

[101] The United Kingdom, Norway and the province of British Columbia all have a form of carbon tax or levy. Norway has been able to reduce its GHG emissions per capita while growing its economy by just over 40 per cent since it introduced its carbon tax in 1991. Currently at C$30/tonne, Norway's carbon levy is similar to what B.C.'s carbon tax is currently expected to be in 2012.

[102] In some cases, benchmarking may also involve considerations of best available technology economically achievable or 'BATEA'.

[103] In fact, a firm's incentives to invest in cleaner technologies for the long-term "are undermined when prices of emissions [permits] are extremely volatile and therefore cloud long-term price signals in the shortterm." J. R. Mason, The Economic Policy Risks of Cap and Trade Markets for Carbon Emissions (The U.S. Climate Task Force, September 2009), 7.

[104] Price collars are a quantity-price hybrid or compromise that reduce price volatility by creating a price floor and a price ceiling for permits. For example, the regulator may set a price floor by guaranteeing a 'minimum reserve price' under permit auctioning while also setting a price ceiling by agreeing to provide additional allowance permits at a pre-set price. See Harrison Fell and Richard Morgenstern, Collaring Price Volatility in a Carbon Offset Market, Resources for the Future, http://www.rff.org/Publications/WPC/Pages/Collaring-Price-Volatility-in-a-Carbon-Offset-Market.aspx (March 15, 2010).

[105] National Round Table on the Environment and Economy, Getting to 2050: Canada's Transition to a Low-emission Future (2007). In its report, the NRTEE notes that a trading system that ramps-up to 100 per cent of allowances or permits being distributed by auction by no later than 2020 would achieve predictable emission reductions while sending a clear price signal to industry.

[106] See supra note 100.

[107] British Columbia has set in place a revenue neutral carbon tax through which, according to the government, "every dollar raised by the carbon tax is returned to individuals and businesses through tax reductions." Government of British Columbia, The Facts on B.C.'s Revenue Neutral Carbon Tax, http://www.gov.bc.ca/fortherecord/carbon/cr_taxpayers.html (May 17, 2010).

[108] 'Offsets' are certified emission reductions that occur in sectors such as agriculture and forestry that are not covered under the cap-and-trade system.

[109] Ontario Regulation 452/09 came into force on January 1, 2010 and requires all Ontario companies with GHG emissions in excess of 25,000 tonnes per year to report annually on their previous year's GHG emissions starting in June 2011.

[110] Government of Ontario, "Ontario to join climate change leaders: McGuinty Government Unites With Provinces, States Tackling Climate Change," News Release, July 18, 2008.

[111] In addition to Ontario, Quebec, Manitoba and British Columbia are WCI members.

[112] Western Climate Initiative, The WCI Cap and Trade Program, http://www.westernclimateinitiative.org/the-wci-cap-and-trade-program (May 17, 2010).

[113] The inclusion of transportation fuels after 2015 could provide an additional nudge to get people out of their cars in those parts of Ontario where there are transit alternatives. "Paying at the pump" (either through a cap-and-trade system or a carbon tax) could help to achieve the increased transit modal share target the ECO has identified in Recommendation 4.

[114] Official Report of Debates (Hansard), Standing Committee on General Government, Environmental Protection Amendment Act (Greenhouse Gas Emissions Trading) 2009 (November 2, 2009).

[115] So-called border adjustment mechanisms are an area of some concern for trade-exposed industries in Ontario and the rest of Canada. They are also referred to as 'carbon tariffs' – an import tax that the U.S. could levy on Canadian products entering the U.S. if these exports are deemed to possess a 'carbon subsidy' due to more lax GHG emissions standards in Canada.

[116] See supra note 103.

[117] See supra note 114, G-1153.

[118] Ibid.

[119] Ibid.

[120] Further, the jurisdiction's trading partners may see the free allocation of permits as an unfair subsidy to local industry, thus imposing a 'carbon tariff' on goods and services that are exported to the trading partner.

[121] The UK has a Climate Change Levy (CCL) which is a levy, or tax, on electricity use. It is intended to promote energy efficiency and thus deliver indirect emission reductions. The European Union Emissions Trading System (EU/ETS) targets direct emissions from large point sources. So a large installation, such as a cement works, might be trading in the EU/ETS with regard to their direct emissions from production of cement, but also pay the CCL on their electricity use.

[122] For example, B.C.'s Ministry of Finance publishes on its website its carbon tax schedule out to 2012. See http://www.gov.bc.ca/fortherecord/carbon/cr_taxpayers.html

[123] For example, the Waxman-Markey American Clean Energy and Security Act was approved in a House of Representatives vote last June, but is stalled in the Senate. In May 2010, Senators Kerry and Lieberman released their American Power Act in the Senate. The Kerry-Lieberman bill includes an emission reductions schedule that is generally consistent with previous legislative proposals, including the Housepassed Waxman-Markey proposal. According to some commentators, the Kerry-Lieberman American Power Act is expected to "usurp other climate legislation that had swirled around the Senate and House, including the Cantwell-Collins Carbon Limits for Energy and American Renewal Act, the Boxer-Kerry Clean Energy Jobs and American Power Act, and the monolithic, House-passed Waxman-Markey American Clean Energy and Security Act." (Delphi Group, Climate Change Policy Update, May 2010).

[124] U.S. Environmental Protection Agency, National Inventory Report – Greenhouse Gas Sources and Sinks in the United States 1990-2008.

[125] See supra note 1.

[126] See supra note 114.

[127] See supra note 105.

[128] David Suzuki Foundation, the Pembina Institute, and WWF-Canada, Comments to the Government of Ontario on the Devel-

opment of a Cap-and-Trade System for Reducing Greenhouse Gas Emissions in Ontario, http://climate.pembina.org/pub/1797 (May 17, 2010).

[129] PricewaterhouseCoopers, The forecast: Evolving Canadian Business Regulations and Incentives Regarding Climate Change: Issue 2, http://www.pwc.com/ca/en/climate-change-newsletter/forecast-issue- 2.html (May 17, 2010).

[130] See supra note 128.

[131] See supra note 3, 62.

[132] See supra note 107.

[133] National Round Table on the Environment and Economy, Achieving 2050: A Carbon Pricing Policy For Canada (2009), 92.

[134] Government of British Columbia, Climate Action Plan, 2008, 16.

[135] Ibid., 19.

[136] The concept of revenue neutrality does have its detractors who claim that it may shift more of the tax burden from the private sector to the public sector because public sector institutions do not pay income taxes and thus do not benefit from tax relief (Harvey Enchin, "The carbon tax conundrum: The more green choices British Columbians make, the less revenue the government will see," Vancouver Sun, April 9, 2010, A15). However, the ECO notes that B.C. and other jurisdictions employing a carbon tax are in the early days of this tax policy articulation.

[137] See supra note 107.

[138] British Columbia Ministry of Finance, Budget and Fiscal Plan, 2010/11 and 2012/13 (March 2, 2010), 106.

[139] See supra note 107.

[140] British Columbia Ministry of Community and Rural Development, "$2.9m in Carbon Taxes Returned to Green Communities," News Release, May 4, 2010.

[141] See supra note 107.

[142] See supra note 133, 100.

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